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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/661,666	09/14/2000	Jianmin Qiao	5298-04100/PM00012	9202

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EXAMINER

PHAM, THANHHA S

ART UNIT	PAPER NUMBER
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2813

DATE MAILED: 11/19/2002

7

Please find below and/or attached an Office communication concerning this application or proceeding.

**Office Action Summary**

Application No.

09/661,666

Applicant(s)

QIAO ET AL.

Examiner

Thanhha Pham

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

- 1) ☒ Responsive to communication(s) filed on 03 September 2002.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

- 4) ☒ Claim(s) 1-5 and 7-27 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 1-5 and 7-27 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

**Application Papers**

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on \_\_\_\_\_ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on \_\_\_\_\_ is: a) ☐ approved b) ☐ disapproved by the Examiner.
- If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

**Priority under 35 U.S.C. §§ 119 and 120**

- 13) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some \* c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- \* See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
- a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

**Attachment(s)**

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) \_\_\_\_\_
- 4) ☐ Interview Summary (PTO-413) Paper No(s). \_\_\_\_\_
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: \_\_\_\_\_

### DETAILED ACTION

This Office Action responds to Applicant's Amendment paper no. 6 dated 9/3/02.

#### ***Claim Rejections - 35 USC § 103***

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

1. Claims 1-5 and 7-8, 10-22 and 24-27 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ko [US 6,337,285] in view of Yanagida [US 5,314,575].

Ko, figs 3-5 and col 1-7, discloses a method for forming a self-aligned contact in a semiconductor device comprising steps:

depositing a substantially continuous dielectric layer (24, doped oxide, fig 3) upon first and second gate laterally spaced gate structures on a semiconductor layer comprising isolation region (undoped oxide, col 4 lines 40-52, col 2 lines 45-49);

etching a first portion of the substantially continuous dielectric layer with a first etch chemistry comprising C<sub>4</sub>F<sub>8</sub> and CO sufficiently to expose a sidewall spacer of said gate structure (see fig 4, col 5 lines 62-67 and col 4 lines 1-22), the first etch chemistry being selective to silicon nitride; and

etching a second portion of the substantially continuous dielectric layer with a second etch chemistry comprising a hydrofluorocarbon etchant including CHF<sub>3</sub>

sufficiently to expose a substrate/the semiconductor layer under said substantially continuous dielectric layer wherein the thickness of the second portion of the substantially continuous dielectric layer is greater than approximately one half of a height of the first and second gate laterally spaced gate structures, the second etch chemistry being different to the first etch chemistry and being selective to undoped silicon oxide and silicon nitride (see fig 5 and col 6 lines 34-62).

Ko et al does not expressly teach that said first etch chemistry must be substantially free of hydrogen. Instead, Ko suggests that said first etch chemistry can be either with or without hydrogen (see col 6 lines 11-20).

Yanagida teaches etching the substantially continuous dielectric layer using a two-step etching wherein the first step of etching using the first etch chemistry substantially free hydrogen to etch the first portion of the substantially continuous dielectric layer with a high rate of etching.

Therefore, it would have been obvious for those skilled in the art to combine the teaching of Yangida to the process of Ko et al to use the first etch chemistry substantially free hydrogen as being claimed to etch the first portion of the substantially continuous dielectric layer to form the self-aligned contact hole in a semiconductor device with low production cost (high production speed by increasing etch rate).

With respect to claims 4-5, 12-14, 18-19, 25-26 ranges of thicknesses of the first and second portions of the substantially continuous dielectric layer, ranges of relative etch selectivity, range of dopant concentration of phosphorous in the substantially continuous dielectric layer are considered to involve routine optimization while has been

held to be within the level of ordinary skill in the art. As noted In re Aller 105 USPQ233, 255 (CCPA 1955), the selection of reaction parameters such as temperature and concentration would have been obvious.

"Normally, it is to be expected that a change in temperature, or in concentration, or in both, would be an unpatentable modification. Under some circumstances, however, changes such as these may be impart patentability to a process if the particular ranges claimed produce a new and unexpected result which is different in kind and not merely degree from the results of the prior art...such ranges are termed "critical ranges and the applicant has the burden of proving such criticality... More particularly, where the general conditions of a claim are disclosed in the prior art, it is not inventive to discover the optimum or workable ranges by routine experimentation."

*See also In re Waite 77 USPQ 586 (CCPA 1948); In re Scherl 70 USPQ 204 (CCPA 1946); In re Imscher 66 USPQ 314 (CCPA 1945); In re Norman 66 USPQ 308 (CCPA 1945); In re Swenson 56 USPQ 372 (CCPA 1942); In re Sola 25 USPQ 433 (CCPA 1935); In re Dreyfus 24 USPQ 52 (CCPA 1934).*

2. Claims 9 and 23 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ko [US 6,337,285] and Yanagida [US 5,314,474] as applied to claim 1 or 17 above, in further view of Ko et al [US 6,117,791].

Ko ('285) in view of Yanagida substantially discloses the claimed method comprising steps of etching the substantially continuous dielectric layer of doped silicon

oxide using the first etch chemistry and the second etch chemistry except teaching the second etch chemistry comprising C<sub>2</sub>H<sub>2</sub>F<sub>4</sub>

However, C<sub>2</sub>H<sub>2</sub>F<sub>4</sub> is a well-known etchant material to dielectric materials. C<sub>2</sub>H<sub>2</sub>F<sub>4</sub> is a well-known material which has been used to improve etching selectivity while etching a dielectric layer. The selection of a known material based on its suitability for its intended use supported a prima facie obviousness determination in *Sinclair & Carroll Co., Inc. v. Interchemical Corp.*, 325 U.S. 327, 65 USPQ 297 (1945).

Moreover, Ko ('791) teaches that C<sub>2</sub>H<sub>2</sub>F<sub>4</sub> is an improved etchant to etch a dielectric layer of doped silicon oxide selectively to both undoped silicon oxide and silicon nitride. It would have been obvious for those skilled in the art to apply the teaching of Ko ('791) to use the second etch chemistry comprising C<sub>2</sub>H<sub>2</sub>F<sub>4</sub> in the process of Ko ('285) and Yanagida to form an improved self-aligned contact with a better-control-etching process to make a better device.

3. Claims 1-5 and 7-27 are rejected under 35 U.S.C. 103(a) as being unpatentable over Chen et al [US 6,025,255] in view of Yanagida et al [US 5,314,575].

Chen et al, figs 4's and col 1-6, discloses a method for forming a self-aligned contact in a semiconductor device comprising steps:

depositing a substantially continuous dielectric layer (28, fig 4D, col 5 lines 24-28) upon first and second gate laterally spaced gate structures on a semiconductor layer comprising isolation region (16);

etching a first portion of the substantially continuous dielectric layer with a first etch chemistry comprising C<sub>4</sub>F<sub>8</sub> sufficiently to expose a sidewall spacer of said gate

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structure (see fig 4E, col 5 lines 48-58), said first etch chemistry being selective to silicon nitride; and

etching a second portion of the substantially continuous dielectric layer with a second etch chemistry comprising a hydrofluorocarbon etchant including CHF<sub>3</sub> sufficiently to expose a substrate/the semiconductor layer under said substantially continuous dielectric layer, wherein the thickness of the second portion of the substantially continuous dielectric layer is greater than approximately one half of a height of the first and second gate laterally spaced gate structures, and the second etch chemistry being different from the first etch chemistry and selective to silicon nitride (see fig 4F, col 6 lines 9-24).

Chen et al fails to teach that said first etch chemistry is substantially free of hydrogen.

Yanagida teaches etching the substantially continuous dielectric layer using a two-step etching wherein the first step of etching using the first etch chemistry substantially free hydrogen to etch the first portion of the substantially continuous dielectric layer with a high rate of etching.

It would have been obvious for those skilled in the art to combine the teaching of Yangida to the process of Chen et al to use the first etch chemistry substantially free hydrogen as being claimed to etch the first portion of the substantially continuous dielectric layer to form the self-aligned contact hole in a semiconductor device with low production cost (high production speed) by increasing rate.

With respect to claims 4-5, 12-14, 18-19, 25-26 ranges of thicknesses of the first and second portions of the substantially continuous dielectric layer, ranges of relative etch selectivity, range of dopant concentration of phosphorous in the substantially continuous dielectric layer are considered to involve routine optimization while has been held to be within the level of ordinary skill in the art. As noted *In re Aller* 105 USPQ233, 255 (CCPA 1955), the selection of reaction parameters such as temperature and concentration would have been obvious. See also *In re Waite* 77 USPQ 586 (CCPA 1948); *In re Scherl* 70 USPQ 204 (CCPA 1946); *In re Irmischer* 66 USPQ 314 (CCPA 1945); *In re Norman* 66 USPQ 308 (CCPA 1945); *In re Swenson* 56 USPQ 372 (CCPA 1942); *In re Sola* 25 USPQ 433 (CCPA 1935); *In re Dreyfus* 24 USPQ 52 (CCPA 1934).

With respect to claims 7, 9 and 23, CO and C<sub>2</sub>H<sub>2</sub>F<sub>4</sub> are well-known etchant materials to dielectric materials. CO is an well-known etchant which has been used to improve etching profile while etching a dielectric layer. C<sub>2</sub>H<sub>2</sub>F<sub>4</sub> is a well-known material which has been used to improve etching selectivity while etching a dielectric layer. The selection of a known material based on its suitability for its intended use supported a prima facie obviousness determination in *Sinclair & Carroll Co., Inc. v. Interchemical Corp.*, 325 U.S. 327, 65 USPQ 297 (1945) (Claims to a printing ink comprising a solvent having the vapor pressure characteristics of butyl carbitol so that the ink would not dry at room temperature but would dry quickly upon heating were held invalid over a reference teaching a printing ink made with a different solvent that was nonvolatile at room temperature but highly volatile when heated in view of an article which taught the desired boiling point and vapor pressure characteristics of a solvent for



printing inks and a catalog teaching the boiling point and vapor pressure characteristics of butyl carbitol. Reading a list and selecting a known compound to meet known requirements is no more ingenious than selecting the last piece to put in the last opening in a jig - saw puzzle).

### ***Response to Arguments***

4. Applicant's arguments filed 9/3/02 have been fully considered but they are not persuasive.

Contradict to Applicant's argument on pages 6-7 that there is no motivation to modify Ko '285 by Yanagida, there is a suggestion of an improvement to combine the teaching of Yanagida to the process of Ko '285. Ko'285 teaches using the first etch chemistry comprising C<sub>4</sub>F<sub>8</sub> to etch a silicon oxide compound (doped silicon oxide such as PSG) in a condition that the first etch chemistry is selective to silicon nitride. Ko '285 teaches using the first etch chemistry with or without hydrogen (CH<sub>2</sub>F<sub>2</sub>, col 6 lines 11-22) when etching the silicon oxide compound (doped silicon oxide, e.g. PSG) selective to silicon nitride. Ko '285 sees that C<sub>x</sub>F<sub>y</sub> (C<sub>4</sub>F<sub>8</sub>, an etchant without hydrogen) primarily decides the etch selectivity to silicon nitride. Yanagida teaches that using the first etch chemistry with substantially free of hydrogen can etch the silicon oxide compound at a high rate. Therefore, there is a motivation to combine the teaching of Yanagida to the process of Ko to use the first etch chemistry comprising C<sub>4</sub>F<sub>8</sub> with substantially free of hydrogen to etch the silicon oxide compound selective to silicon nitride at an improved etch rate.

Contradict to Applicant's argument on pages 7-8 that there is no motivation to modify Chen as suggested in the Office Action, there is a suggestion in combining the teaching of Yanagida to the process of Chen. Chen teaches using the first etch chemistry comprising C<sub>4</sub>F<sub>8</sub> to etch a silicon oxide compound selective to silicon nitride. Yanagida teaches using the first etch chemistry comprising C<sub>4</sub>F<sub>8</sub> with substantially free of hydrogen to etch the silicon oxide compound with a better etch rate. Therefore, it would have been obvious for those skilled in the art to combine the teaching of Yanagida to the process of Chen to etch a first portion of the dielectric layer (the silicon oxide compound) selective to silicon nitride by using the first etch chemistry comprising C<sub>4</sub>F<sub>8</sub> with substantially free hydrogen to improve etching rate.

Contradict to Applicant's argument on pages 8 and 9 that **"The cited prior art does not disclose etching a first portion of a dielectric layer with a first etch chemistry that is substantially free of hydrogen and etching a second portion of the dielectric layer which has a thickness greater than about one half a height of gate structures with a second etch chemistry"** and **"The cited art does not disclose etching the first portion of a substantially continuous dielectric layer adjacent to the gate structure with a first etch chemistry substantially free of hydrogen sufficiently to expose a sidewall spacer of the gate structure and etching a second portion of the dielectric layer with a second etch chemistry including hydrofluorocarbon etchant sufficiently to expose a substrate under the dielectric layer"**, combination of Ko in view of Yanagida and combination of Chen in view of Yanagida teaches these. Applicant obviously directs the arguments to the references individually, not the combination here under 35 U.S.C 103. Obviousness is determined on the basis of the evidence as in a whole. Unobviousness cannot be established by attacking references individually when

rejection is based on combination of references. See *In re Young* 159 USPQ 725 (1968) and *In re Keller* 208 USPQ 871 (1981).

Regard to Applicant's request citation of a reference supporting "CO is a well known etchant which has been used to improve etching profile when etching dielectric layer", Examiner submits herein 2 other references Zhu et al [US 6,297,163] and Inazawa et al [US 5,595,627] that teaches advantage using CO in etching dielectric layer.

### **Conclusion**

5. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

6. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Thanhha Pham whose telephone number is (703) 308-

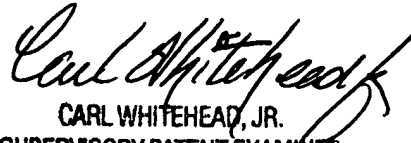
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6172. The examiner can normally be reached on Monday-Thursday 8:00 AM - 7:00 PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Carl Whitehead Jr., can be reached on (703) 308-4940. The fax phone numbers for the organization where this application or proceeding is assigned are (703) 308-3432 for regular communications and (703) 308-7725 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 308-0956.

Thanhha Pham  
November 15, 2002

  
CARL WHITEHEAD, JR.  
SUPERVISORY PATENT EXAMINER  
TECHNOLOGY CENTER 2800